TECHNICAL REPORT 1

UNIVERSITY BUILDING
UNIVERSITY, MID ATLANTIC REGION, UNITED STATES

Jeremy Feath

Dr. Dubler

9/16/2013

Executive Summary

Client Information:

The University Engineering Building is the new state-of-the-art research building for a University located in the Mid Atlantic region of the United States. Due to a request by the owner, certain information must remain confidential. The funding for this project came from an alumnus with a portion matched by the state. As with any university project, the number one priority is the safety of the students and faculty and workers. Since this building will be representing the College of Engineering quality outweighs time and cost. Specific end users are currently undecided, with lab space and office space still needing to be assigned to different majors. Chemical/Bio Engineering majors upon completion will use the clean room. The University is going for LEED certification, but a final rating is yet to be determined.

Project Delivery Method:

Design-bid-build is the project delivery system used on the University Engineering Project. The University's Department of Construction is acting as an owner's rep/CM Agent. Stantec Architecture is contracted through lump sum pricing, to the University to handle all design work. Stantec contracted the structural work to Barber & Hoffman and the clean room design to Innovate Labs Systems Design, both also lump sum. Massaro Corporation is the general contractor on the project and has a lump sum contract with the University. Originally Hodess Construction, the clean room contractor, was supposed to be subcontracted to Massaro but now has a lump sum contract directly with the owner. Please see slide 3 on the presentation for a list of some prime subcontractors.

Project Staffing Plan:

Massaro's lead on the project is Todd B. He described his role as project manager/project engineer. In this role his duties are that of a typical project manager more so than project engineer, which include cost and budget management as well as meeting with the University for progress reports and weekly meetings. He is also the BIM coordinator on the project, which includes creating a full building model and overseeing all coordination meetings with subcontractors. The superintendent on the project handles all duties typical of a superintendent. The project engineer also has the same duties of a project engineer, such as handling RFIs and submittals. For a complete staffing plan, refer to slide 4.

Existing Conditions Plan:

The University Engineering Building is located on undeveloped University land. Existing utilities run through the building's perimeter to feed adjacent existing buildings. Temporary utilities for the project site will come from a variety of sources. Water, storm, sanitary and gas lines will be supplied from the University's main water lines. Temporary electric will be fed from the Plant/Soils Building. Temporary walkways have been created for pedestrian use. An existing parking lot located south of the project site will still be in use by faculty, while roads located on the east and west sides are designated construction use only.

Building Systems Summary:

Very little demolition was required for the University Engineering Building. Existing walkways and part of a roundabout were removed. Concrete and asphalt were the materials removed. A benched back system was used for excavation support, with pumps and a sump box used for dewatering. The sump box will become permanent upon completion. Structural steel is being placed by (1) 80 ton crawler crane, with x-bracing used. Almost all of the foundation work is cast in place concrete. Treated wood and precast lagging panels were used as formwork, with pump trucks, buckets and regular pours as the placement methods. As stated before, the only precast concrete is lagging panels for the foundation walls. A small rubber tire crane was used to aid the placement of concrete.

In order to accommodate complex laboratory equipment, a detailed and intensive mechanical system is required. The 0 and Mezzanine levels house all the mechanical equipment used to supply the clean room and part of Level1. The penthouse mechanical system supplies the rest of the building. Large air handling units equipped with heat recovery units supply all air to the building. For the electrical system, (2) building service entries are being used. Each are equipped with a 2500 kVA transformer, with both supplying power to all distribution panels and equipment. Brick veneer is being used for the exterior enclosure. A combination of red brick and limestone is used for architectural effects. The curtain wall system utilizes an aluminum frame and tinted glass. Sections will be assembled off site at the manufacturer's plant and shipped to the site.

Project Summary Schedule:

The University Engineering Building has a current schedule duration of roughly 2 years. Funding for the project was announced in January 2012, with the design and procurement phases taking place over the next year. Construction began one year later and as of the most recent updated project schedule, occupancy will occur in early January 2015, in time for the Spring 2015 semester. Structural steel is the current phase of construction, with expected completion in October. The rough-in and finishes phase will take the most time, due to the complexity of the building's mechanical system. The project is sequence throughout all phases begin with work on the laboratory building and then moving to the office building. The lab wing is the more important of the two, in terms of reaching deadlines because of the expensive and custom

equipment that is being installed and the need for strict environmental controls. Project milestones are listed with slide 8.

Project Cost Evaluation:

A cost evaluation was performed with the following results. The actual total project cost is $43M and total construction cost is $32.7M. A square foot estimate was performed for both a laboratory (2/3) and office (1/3) space. The laboratory estimate totaled $11.3M and the office estimate totaled $6.8M. The total was less than half of the total project costs, but this was due to a number of reasons. The clean room itself was roughly $1.5M and the mechanical contract was $11M. The mechanical and plumbing contract was so large due to the fact of the detailed systems involved. All of the air-handling units are custom made and account for roughly $1M of the total contract, along with other highly technical equipment used and major duct runs account for a large portion of the cost. Also lab equipment which is not typically used in buildings accounts for the remainder of the cost. The mechanical estimate for both building types totaled $2.4M. Lab and office equipment will also make up a majority of the difference.

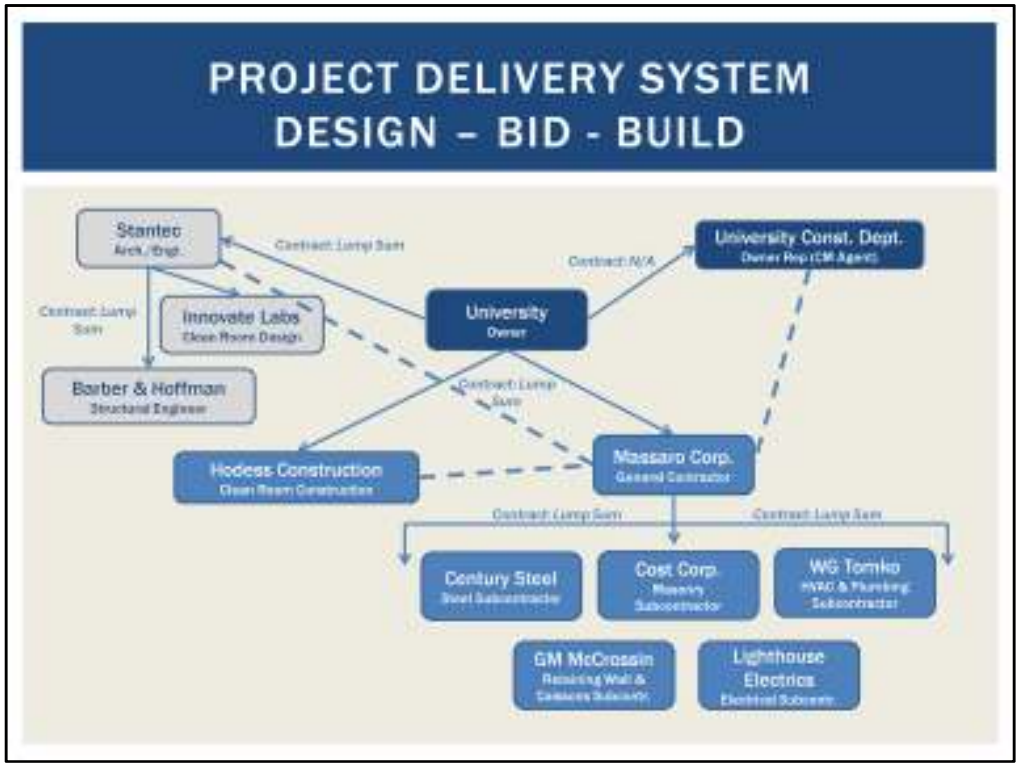
UNIVERSITY ENGINEERING BUILDING

UNDISCLOSED UNIVERSITY, MID ATLANTIC REGION, UNITED STATES

Technical Assignment 1

Jeremy Feath
Advisor: Dr. Dubler
09/16/2013

- According to University: Clean Room will most likely be used by Chemical/Bio Engineering Majors. The rest of the lab and office space is currently being assigned to different majors. Classrooms will most likely house different sorts of classes, but University has yet to make any concrete schedules.
- The College of Engineering is being renamed after the Alumnus, making this building the featured Engineering building on campus.
- University's Safety Plan is rather poor, relying on the GC to keep the site locked down and only notifying buildings when construction work affects them.
    - Example: Crane pick causes the swing path to pass over an occupied building. The University notifies the building and the building has the responsibility to notify students.
    - The Student Safety issue is being considered as a possible Spring analysis.
- The University itself will act as the Facility Manager. Their Construction Department acts similar to Penn State's OPP.
- High Level of quality is expected and required especially with the complexity of the clean room.



- The University's Construction Department is a pure CM on this project, acting as oversight on construction.
- Stantec handled all architectural and engineering needs except for structural and the clean room.
- Lump Sum contract was assumed between Owner and Stantec. (Owner Rep I spoke to did not want that information revealed)
- Hodess Construction was originally contracted to the owner, but was supposed to be then contracted to Massaro, but that fell through and thus remained contracted to the owner.
- Massaro is self performing rough carpentry and concrete work, aside from retaining wall and caissons.

- The core team that is on site most of the day is Todd B. and Chuck H. and everyone below them.
- Todd B. is also acting as the BIM Coordinator on the project.
    - Massaro is using a 3D model for mainly the mechanical systems, specifically in the mezzanine, to better coordinate due to the complexity of the mechanical system used for the clean room. Todd is currently beginning to work on creating a 4D model to link the schedule.

- New Engineering Building lies on undeveloped land. (Demolition covered in Building Systems Summaries)
- Existing utilities ran through and around project location in order to connect to existing buildings. The new building will tie into existing utilities for temporary needs, power will be supplied from Plant/Soils Building directly east.
- Roads entering the site from the West and Northeast are designated construction roads, not to be used by the public, hence the dashed orange lines.
- The parking located to the South of the building will remain in use by University employees.
- Walkways around the site are designated for student and pedestrian use. The limits of construction line also is the site fencing used to keep the job site secure.
- An underground spring was discovered during excavation that was not detected on the geo-tech report, which caused delays in foundation work and required the addition of a sump pump.

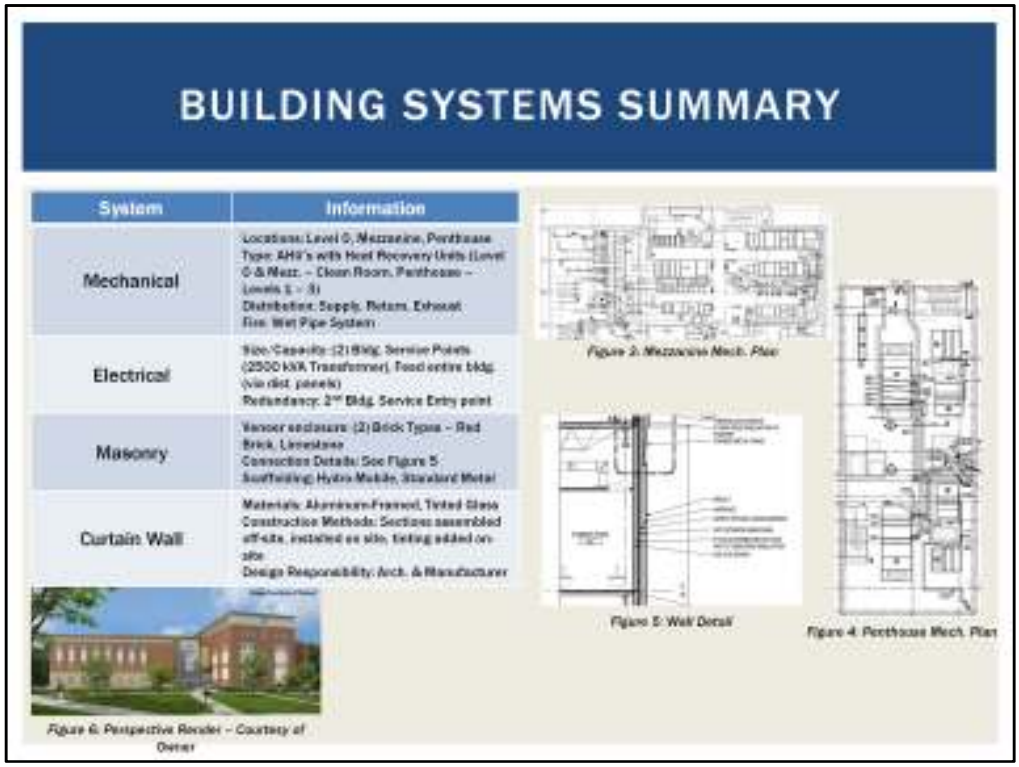
BUILDING SYSTEMS SUMMARY

System	Information
Demolition	Concrete, Bituminous Paving, Asphalt Removed, Protection of Trees
Excavation	Support System: Benched Back, Retaining Wall Dewatering System: Pump system, Sump Box (To be permanent)
Structural Steel	Tension (1) Bearing (1) – 80 ton Crawler Crane (covers whole site)
Cast-in-place Concrete	Standard Wood Formwork, Precast Lagging Panels Placement Methods: Bucket (w/ Lull), Pump Truck, Back of Concrete Truck
Precast Concrete	Location: Lagging Panels for Retaining Wall Connection Method: Cast-in-place Concrete Rubber Tire Crane used for placement

Figure 1: Demolition Plan

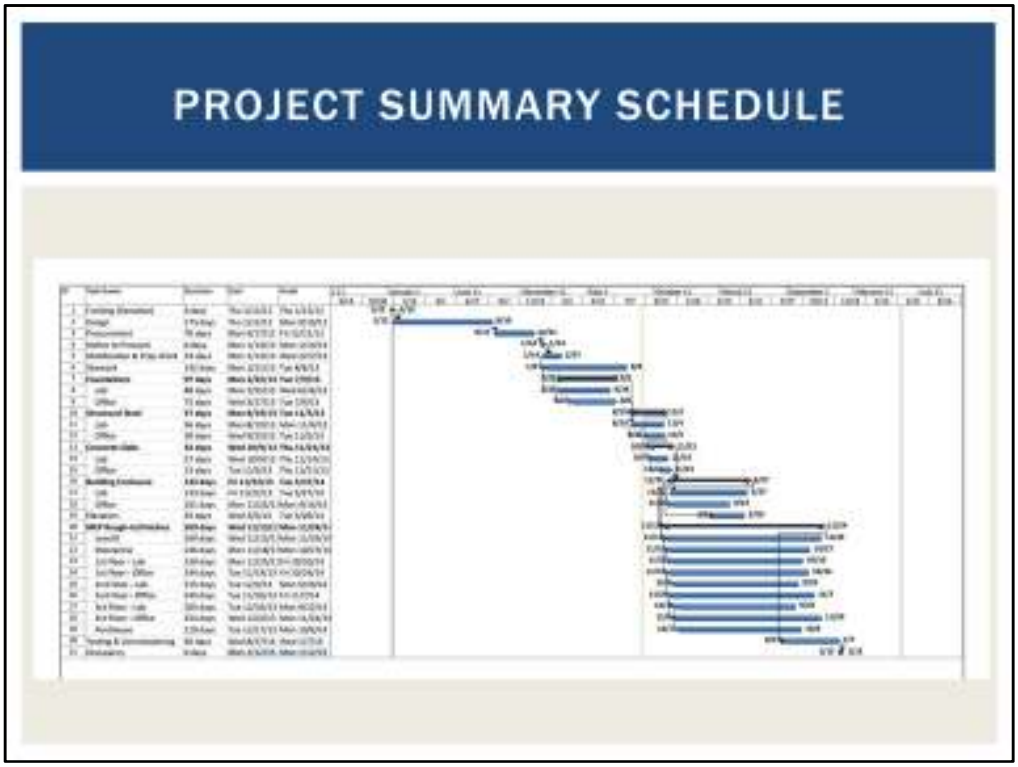
Figure 2: Foundation/Steel – Courtesy of Owner

- Land was undeveloped by University prior to this building. There is a tight constraint on the north end due to a major roadway.
- Many issues arose during excavation because of dewatering. Bad weather and already present water caused forms to shift and rebar cages to move. This lead to daily inspections of concrete pour forms to insure that everything was correct. Future analysis for tech 2 constructability challenges.
- Cranes: The 80-ton Crawler is the primary crane used on site. It is handling all steel work. The Rubber Tire crane was smaller and only used for concrete purposes involving the foundation.
- The Sump Box was installed in the Southeast corner of the building and was purposefully designed to become a permanent sump box after completion of the project.
- Formwork is typical treated wood, soldier pile lagging was also used at certain areas for foundation wall.

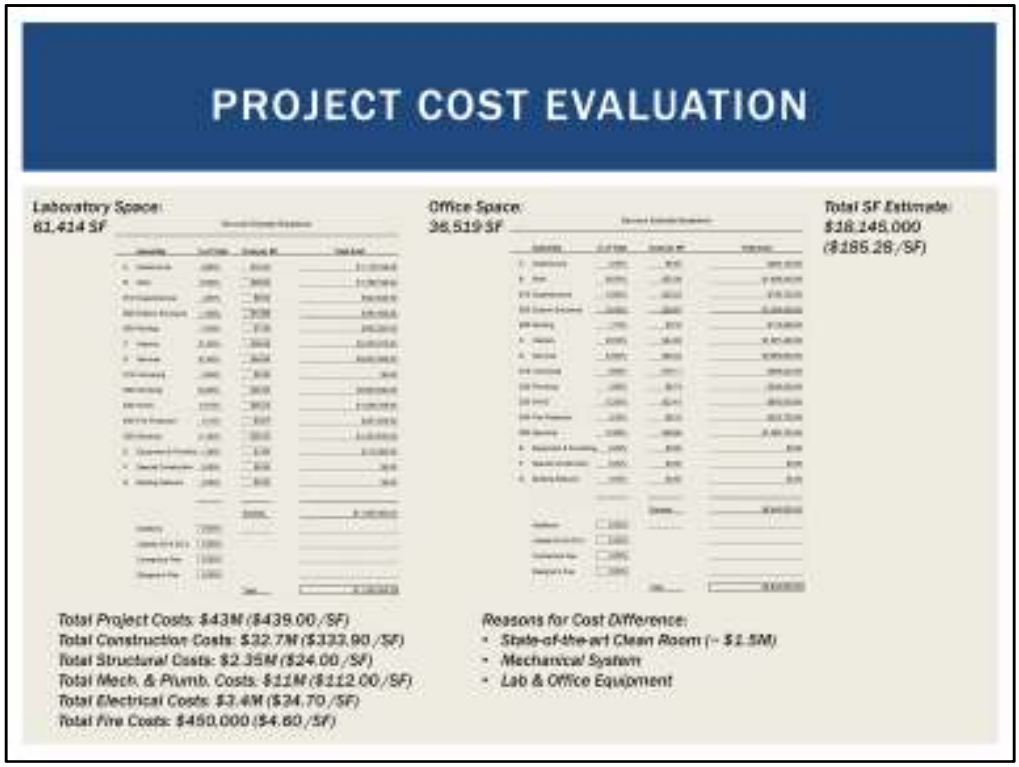


- The Level 0 and Mezzanine Mechanical systems are almost entirely dedicated to the clean room and level 0. The Penthouse mechanical system is dedicated to the remaining above grade levels. It's an air-to-air system, supplied by only Air Handling Units, heating is handled by heating recovery units.
- The masonry subcontractor is still entertaining the idea of using the hydro-mobile scaffolding in particular areas, but most areas will be completed using a standard metal scaffolding.
- V-M Products, Inc. is handling the installation and manufacturing of the curtain wall. Assembly occurs at their manufacturing plant and will deliver them on site where they'll be installed and tinted after installation. The wall ties into structural steel members that span the length of the wall.
- The Engineering Building will supply it's own electricity, with transformers and generators located on the southeast area of the building. The transformers are 4160 V. The redundancy is due to the size of the system, as they felt is would be safer to use two entry points rather than one, also in case of one transformer breaking down for whatever reason. Backup power is crucial when there is important research going that needs specific conditions to be maintained.

PROJECT SUMMARY SCHEDULE



- Each activity is phased due to the separate wings. The Lab wing typically comes first because it is larger and requires more intensive interior work.
- Long rough-in durations are due to the amount and size of the mechanical equipment and materials located in the building.
- The period between receiving the funding for the building and start of construction was 1 year. The website used to gather information on the donation compromises the owner's identity, a full url address can be provided, but it was the University's news publication.
- Occupancy is shooting for the start of the Spring 2015 semester.
- Project Milestones:
    - Notice to Proceed: 14 Jan. 2013
    - Foundation Completion: 9 July 2013
    - Topping Out: 5 Nov. 2013
    - Concrete Complete: 21 Nov. 2013
    - Enclosure: 27 May 2014
    - Clean Room Complete: 3 Dec. 2014
    - Rough-In/Finishes Complete: 24 Nov. 2014
    - Testing & Commissioning: 7 Jan. 2015
    - Building Turnover: 12 Jan. 2015



- SF estimate was split into two different building types because the Office space and Lab space are separate wings of the building.
- The Mech. and Plumbing cost is not surprising due to the size and scope of the mechanical system.
- The total SF estimate was expected to remain around half of the actual total project costs.
- The clean room occupies 9,000 SF of space, giving it a cost of $167.00 /SF.
- A 2’-8” story height adjustment was made, along with adjusting for the perimeter.
- Building perimeter = 849 LF (Lab overestimated perimeter, Office underestimated perimeter)
- Location factor of 0.95 was used for the city where the University is located.
- RS Means 2013 SF Estimate book was used, so no inflation factor was used.
- Inflantion was not taken into account in these calculations.